Accordingly, the Primary Examiner's comments in Section 1 of the Office Action are traversed.

Sharnoff, et al. do not disclose a holographic printer, but rather apparatus for the fine comparison of closely related images of a three dimensional object "such as those that may arise in holographic interferometry." (See Abstract; see also, col. 2, *ll.* 66-67.) "Collation" is used to refer to the "fine comparison of closely related images." (See Abstract.) The quality of the collation is "judged by the degree to which the two images are brought into destructive interference." (See, col. 3, *ll.* 66-68.) In contrast, Applicant's invention relates to holographic printers, particularly printers that produce first generation, white light viewable holograms. It does not relate to "collation," holographic interferometry, holo-photoelasticity or speckle interferometry.

In Sharnoff, et al., images of a three dimensional object (which is not the same as Applicant's two dimensional image) are recorded in pairs in which one "reference wave" is used to encode one image of the pair and the other "reference wave" is used to encode the second image of the pair. (See col. 1, *ll.* 39-43.) After the two holograms are recorded and the holographic plate developed, the developed plate is returned to the position and orientation it occupied during its exposure and illuminated with the same two reference waves. (See col. 1, *ll.* 49-55.) This second illumination is intended "to produce nearly complete destructive interference between the two reconstructed images." (Again, see col. 1, *ll.* 49-55.) The small differences between the original images is conveyed by the residual intensity in the interference pattern of the two reconstructed images and can be recorded. (See col., 1, *ll.* 55-62.)

The basic apparatus, which permits a pair of holograms to be recorded sequentially, is illustrated in Figure 1 of Sharnoff, et al. The apparatus includes a laser 1, a shutter 3, and a beam splitter 5 which divides beam 4 into two sub-beams 6 and 7. Sub-beam 6 is further divided into sub-beams 9 and 10. Each of sub-beams 7, 9 and 10 is associated with, respectively, shutter 12, 11 and 13. Sub-beams 9, 14, 16 and 18 serve as a first reference wave, while sub-beams 10, 21, 23 and 25 serve as the second reference wave. Sub-beams 7, 26, 28, 30, 34 and 35 represent the object wave. In operation , as set forth in col. 8, *ll.* 1-9:

> Shutters 3 and 12 are both open, and at least one of shutters 11 and 13 are also open, during the exposure of the photographic emulsion at 19 to record the pattern of interference between the object wave 34-35 and reference wave 18. Shutters 3 and 12 are both open, and at least one of shutters 11 and 13 are also open, during the exposure of the photographic emulsion 20 [sic - this should be 19] to record the pattern of interference between 34-35 and 25.

The rejection of claims 1, 15 and 25 as anticipated by Sharnoff, et al is traversed. First, Sharnoff et al do not disclose any "means, ..., for positioning an image in said object path." Object 31 is a three dimensional object, not a means for positioning an image. Secondly, as now amended, Sharnoff et al do not disclose a "means, ..., for dividing said reference beam into at least three substantially identical reference beams" as set forth in sub-paragraph (e) of claim 1. Finally, as set forth above, Sharnoff et al. relates to apparatus for the fine comparison of closely related images, while Applicant is claiming a printer.

The rejection of claim 25 is additionally traversed in that Sharnoff et al. fail to disclose or suggest any means for beam manipulation. Column 1, *ll.* 52 -55 refers to adjusting "the relative intensities and phases of the two reference waves." Further, at col. 1, *ll.* 65-66, there is a reference to "further manipulations of the phases of the two reference

waves." However, this is after the holograms are recorded, developed and the recording medium is "returned to the position and orientation it occupied during its exposure." See col., 1 *ll.* 50-52. This is also true of the discussion of the "scrutiny of such an interference pattern" as discussed in col. 18, *l.* 57 - col. 19, *l.* 17. Further, a beam splitter is not a "means for beam manipulation" as disclosed and claimed by Applicant.

The rejection of claims 12 and 16 is also traversed. Speculation that "[t]he shutter of Sharnoff et al. may have already been a liquid crystal device ... " is not a substitute for a reference showing the use of Applicant's claimed shutters in a holographic printer.

As to claims 17-20, not only does Sharnoff et al. "not teach explicitly that either of a transparency or of a liquid crystal panel provides the object information" (as set forth in Section 8 of the Office Action), it explicitly teaches placing a three dimensional object in the object plane. See "object" 31 in Figures 1, 5 and 6. The embodiment of Figure 7 relates to determining stress distribution. "[T]he test subject at 68 is mounted on a planer stressing device." See col. 17, *ll.* 20-23. Further, Hart is not the same field of endeavor as Sharnoff et al. As stated above, Sharnoff et al. relates to the fine comparison of clearly related images, such as those that may arise in holographic interferometry, in holo-photoelasticity or in speckle interferometry. In contrast, Hart relates a method and apparatus to produce a laser viewable hologram, that has to be printed a second time to produce a white light viewable hologram. (Which makes it more complicated than Applicant's printing process.) The source of images in Hart (in contrast to Sharnoff, et al.) is a computer (not shown) which interfaces with CRT 444. See col. 13, *ll.* 54-55. Hart (col. 13, *l.* 57 - col. 14, *l.* 6) operates as follows:

> More particularly, a first data slice is projected by CRT 444 onto light valve 442. As explained in greater detail below, the image corresponding to the data slice is projected onto film 319 for a predetermined amount of time sufficient to permit film 319 to capture (record) a fringe pattern associated with that data slice and thereby create a hologram of the data slice within the emulsion comprising film 319. Thereafter, a subsequent data slice is projected by projection assembly 328, track assembly 334 [and, thus, the film] is moved axially in accordance with the distances between data slices, and a subsequent hologram corresponding to the subsequent data slice is superimposed onto film 319. This process is sequentially repeated for each data slice until the number of holograms superimposed onto film 319 corresponds to the number of data slices 14 comprising the particular volumetric data set 16 which is the subject matter of the master hologram being produced.

Hart (col. 14, *ll.* 29-32) further states that:

> In particular, the beam generated by CRT 444 corresponding to the data slice typically comprises light regions corresponding to bone, soft tissue, and the like, on a dark background.

From the foregoing it is clear that Hart and Sharnoff et al. do not relate to the same fields of endeavor. There would be no motivation to one ordinarily skilled in the art to modify Sharnoff et al. based on Hart. To do so, even if it was possible, would destroy the utility of Sharnoff et al. Accordingly, the rejections based on Sharnoff et al. and Hart are traversed.

The rejection of claim 26 is traversed for the reasons set forth above with regard to claim 1. Secondly, the rejection is traversed for the reasons set froth with regard to claim 25. Finally, there is no teaching or suggestion in either of Sharnoff et al., or Psaltis et al. to insert a cylindrical lens in any of the embodiments of Sharnoff et al. Sharnoff et al. and Psaltis et al. are non analogous. As stated above, Sharnoff et al. relates to holographic interferometry, while Psaltis relates to holographic storage and holographic memory. (See col. 1, Technical Field.) As stated in col. 10, *l.* 66 - 66. 11, *l.* 8.:

> While the invention has been described with reference to embodiments in which the reference lens 20 is spherical (so as to provide either a fan of plane waves as in FIG.11 or a single spherical wave as in FIG 6), the shift multiplexing of the invention described above may also be achieved using different types of reference beams other than a single plane wave. For example, cylindrical waves may be employed (in which case the reference lens 20 is a cylindrical lens) or elliptical waves may be employed (in which case the reference lens 20 is an elliptical lens).

Since Sharnoff et al. does not utilize cylindrical waves, the use of a cylindrical lens for the purpose taught by Psaltis et al. would destroy the utility of Sharnoff et al.

With regard to the rejection set forth in Section 10, Sharnoff et al. does not meet "all the limitations of the claims with the exception that it does not teach explicitly that the dual images being recorded are obtained by changing the image on the object beam." Sharnoff et al. have an object 31 in the object beam. Between the first exposure (the object wave and, for instance, reference wave 9, 14, 16, and 18) and the second exposure (the object wave and reference wave 10, 21, 23 and 25) the object is <u>not</u> changed. If it were the utility of Sharnoff et al. would be destroyed. In contrast, claim 37, subparagraph (e) requires "changing said images" between exposures. Hart does change images after each exposure. However, this is not for the purpose of "nearly destructive interference" (Sharnoff et al., col. 1. ll 49-55), but to create a holographic composite of a plurality of images. Thus, Sharnoff et al. and Hart are non-analogous art. The obviousness suggested by the Examiner, if it were possible, would simply destroy the utility of Sharnoff et al. Accordingly, the rejection of claims 37 and 38 is traversed.

In view of the foregoing, it is submitted that claims 1, 12, 15-20, 25, 26, 37 and 38 are in condition for allowance. Given that claim 1 (as amended) should be allowed, reconsideration of the withdrawal of dependent claims 2-9, 23 and 24 is requested. All

depend from claim 1. Further, none of the references of record disclose either the optical fibers of claims 2-9 or the diffuser of claims 23 and 24.

Respectfully submitted,

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I claim:

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1. A holographic printer comprising:

(a) a source of coherent light;

(b) means for dividing said source into an object beam and a reference beam, said object beam having a beam path, said reference beam having at least one beam path;

(c) means, positioned along said object beam path, for positioning an image in said object beam path;

(d) means for supporting a recording medium in both said object beam path and said reference beam path;

(e) means, positioned along said reference beam path between said dividing means and said recording medium support, for dividing said reference beam into at least three substantially identical reference beams, each having its own path, each of said reference beam paths intersecting said object beam path at said recording medium support; and

(f) a plurality of shutter means, said plurality of shutter means including a shutter means positioned in said object beam path between said means for dividing and said recording medium support, said plurality of shutter means also including a shutter means for each of said at least three reference beams.

2. The printer of claim 1, wherein said means for dividing includes a plurality of optical fibers.

13. [cancelled].

14. [cancelled].

B2 Sub C3

15. The printer of claim 1, further including shutter control means for controlling each of said plurality of shutter means, said shutter control means including means for sequentially opening each of said reference beam shutter means, said shutter control means also including means for opening also including means for opening said object beam shutter each time one of said reference beam shutter means is opened.

16. The printer of claim 15, wherein said plurality of shutter means are non-mechanical.

17. The printer of claim 1, wherein said means for positioning an image includes means for holding a transparency.

18. The printer of claim 1, wherein said means for positioning an image is a liquid crystal panel.

19. The printer of claim 18, further including means for suppling images to said liquid crystal panel.

20. The printer of claim 19, wherein said means for supplying images includes computer means.

21. [cancelled].

22. [cancelled].

23. The printer of claim 1, further including a holographic diffuser, said diffuser positioned in said object beam path adjacent said means for positioning an image.

24. The printer of claim 23, wherein said holographic diffuser element includes two elliptical holographic diffusers positioned relative to each other such that the principal axis of one is perpendicular to the principal axis of the other.

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25. The printer of claim 1, wherein each of said at least three reference beams includes means for beam manipulation.

26. The printer of claim 25, wherein each of said means for beam manipulation includes a cylindrical lens.

27. The printer of claim 26, further including means, positioned along said object beam path between said dividing means and said recording medium support, for dividing said object beam into a plurality of object beams, each having its own path, each of said object beam paths intersecting said reference beam paths at said recording medium support, each of said object beams further including beam focusing means in the form of cylindrical lenses.

28. The printer of claim 27, wherein said means for dividing includes a plurality of optical fibers.

29. The printer of claim 28, wherein each of said plurality of fibers has the same length.

30. The printer of claim 29, wherein said means for dividing is a polarization maintaining splitter array.

31. A color holographic printer comprising:

(a) a plurality of sources of coherent light, each of said sources having a different wavelength;

(b) means for combining said different wavelengths into a single beam;

I claim:

1. A holographic printer comprising:

(a) a source of coherent light;

(b) means for dividing said source into an object beam and a reference beam, said object beam having a beam path, said reference beam having at least one beam path;

(c) means, positioned along said object beam path, for positioning an image in said object beam path;

(d) means for supporting a recording medium in both said object beam path and said reference beam path;

(e) means, positioned along said reference beam path between said dividing means and said recording medium support, for dividing said reference beam into at least three substantially ~~a plurality of~~ identical reference beams, each having its own path, each of said reference beam paths intersecting said object beam path at said recording medium support; and

(f) a plurality of shutter means, said plurality of shutter means including a shutter means positioned in said object beam path between said means for dividing and said recording medium support, said plurality of shutter means also including a shutter means for each of said at least three ~~plurality of~~ reference beams.

2. The printer of claim 1, wherein said means for dividing includes a plurality of optical fibers.

13. [cancelled].

14. [cancelled].

15. The printer of claim 1~~14~~, further including shutter control means for controlling each of said plurality of shutter means, said shutter control means including means for sequentially opening each of said reference beam shutter means, said shutter control means also including means for opening also including means for opening said object beam shutter each time one of said reference beam shutter means is opened.

16. The printer of claim 15, wherein said plurality of shutter means are non-mechanical.

17. The printer of claim 1, wherein said means for positioning an image includes means for holding a transparency.

18. The printer of claim 1, wherein said means for positioning an image is a liquid crystal panel.

19. The printer of claim 18, further including means for suppling images to said liquid crystal panel.

20. The printer of claim 19, wherein said means for supplying images includes computer means.

21. [cancelled].

22. [cancelled].

23. The printer of claim 1, further including a holographic diffuser, said diffuser positioned in said object beam path adjacent said means for positioning an image.

24. The printer of claim 23, wherein said holographic diffuser element includes two elliptical holographic diffusers positioned relative to each other such that the principal axis of one is perpendicular to the principal axis of the other.

25. The printer of claim 1, wherein each of said at least three ~~plurality of~~ reference beams includes means for beam manipulation.

26. The printer of claim 25, wherein each of said means for beam manipulation includes a cylindrical lens.

27. The printer of claim 26, further including means, positioned along said object beam path between said dividing means and said recording medium support, for dividing said object beam into a plurality of object beams, each having its own path, each of said object beam paths intersecting said reference beam paths at said recording medium support, each of said object beams further including beam focusing means in the form of cylindrical lenses.

28. The printer of claim 27, wherein said means for dividing includes a plurality of optical fibers.

29. The printer of claim 28, wherein each of said plurality of fibers has the same length.

30. The printer of claim 29, wherein said means for dividing is a polarization maintaining splitter array.

31. A color holographic printer comprising:

(a) a plurality of sources of coherent light, each of said sources having a different wavelength;

(b) means for combining said different wavelengths into a single beam;